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# Conservation Assessment of the Southwestern Showy Sedge in the Black Hills National Forest, South Dakota and Wyoming

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of  
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in the  
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South Dakota and Wyoming**

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## EXECUTIVE SUMMARY

Southwestern showy sedge, *Carex bella* Bailey, is a caespitose graminoid that occurs in the central and southern Rocky Mountain region of the western United States and Mexico, with a disjunct population in the Black Hills that may be a relict from the last Pleistocene glaciation (Cronquist *et al.*, 1994; USDA NRCS, 2001; NatureServe, 2001).

Southwestern showy sedge is quite restricted in range and habitat in the Black Hills. There is much that we don't know about the species, as there has been no thorough surveys, no monitoring, and very few and limited studies on the species in the area. Long term persistence of southwestern showy sedge is enhanced due to the presence of at least several populations within the Black Elk Wilderness and Custer State Park. Populations in Custer State Park may be at greater risk due to recreational use and lack of protective regulations (Marriott 2001c).

Southwestern showy sedge occurs in cool, moist, shaded, high elevation sites in the Black Hills, but at elevations well below those reported for other parts of its range in the Rocky Mountains. This suggests the species may already be approaching its limits in terms of habitat availability in the Black Hills under present climatic conditions. Southwestern showy sedge occurs in three populations in Black Elk Wilderness and in several populations in the adjacent Custer State Park (SDNHP, 1973, 2000, 2001). One small sub-occurrence reported in the Black Hills area from near the outlet of Sylvan Lake in Sunday Gulch in Custer State Park has not been observed since 1987 and presumably has been lost to hiking and climbing access traffic. No other monitoring data is available for Black Hills populations.

The basic management objectives for Black Elk Wilderness provide a good process-based conservation framework for minimizing risks to southwestern showy sedge in Black Hills National Forest. The most significant management related risk factors appear to be generally localized physical disturbance such as that which could be caused by dispersed recreation such as hiking, camping, and climbing. Extended drought, and global or regional warming are the predominant natural risk factors.

Key words: southwestern showy sedge, *Carex bella*, Black Hills, Black Elk Wilderness.

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## INTRODUCTION

Southwestern showy sedge, *Carex bella* Bailey, is a caespitose graminoid that occurs in the central and southern Rocky Mountain region of the western United States and Mexico, with a disjunct population in the Black Hills (Figures 1-2) (Cronquist *et al.*, 1994; USDA NRCS, 2001; NatureServe, 2001). Across its range, the species' conservation status is secure except for the disjunct populations in the Black Hills (NatureServe 2000) which are likely relicts from a northward expansion of a high elevation, more southerly species during the last Pleistocene glaciation 11,000 years ago (Froiland 1999).

In the Black Hills, southwestern showy sedge occurs in three populations in the Black Elk Wilderness and in several small populations in the adjacent Custer State Park (SDNHP, 1973, 2000, 2001). The southwestern showy sedge population at the head of Nelson Creek is the largest in Black Hills National Forest with approximately 75-100 fruiting stems counted (SDNHP, 2000). Southwestern showy sedge populations are found in cool, moist, high elevation sites in the Black Hills, but are still at elevations well below those reported for other parts of its range in the Rocky Mountains.

The earliest known occurrence of southwestern showy sedge in South Dakota was reported in 1924 from Sunday Gulch below Sylvan Lake in Custer State Park. One small sub-occurrence reported in the Black Hills area from near the outlet of Sylvan Lake in Sunday Gulch in Custer State Park has not been observed since 1987 and is believed to have been extirpated, presumably due to recreational traffic (Ode, 2001). In 2000, three occurrences of southwestern showy sedge were located in Black Elk Wilderness (SDNHP, 2000). Several additional occurrences were also found in Custer State Park (SDNHP, 2000, 2001).

The objective of this assessment is to review the status of southwestern showy sedge in the Black Hills and to synthesize information relevant to its management and long-term persistence. Published literature on southwestern showy sedge and its habitats is sparse and other sources and analogous information were important in developing this assessment. The USDA, NRCS PLANTS Database is referenced extensively in this document, although the geographical basis and source of specific habitat data is unknown and may not be directly applicable to the Black Hills in all instances. This document was developed in accordance with content and format requirements defined by Black Hills National Forest.

## CURRENT MANAGEMENT SITUATION

### Management Status

#### *International*

Global Conservation Status Rank: G5; secure worldwide, but possibly quite rare in parts of its range, especially at the periphery (NatureServe 2001).

#### *Federal*

Southwestern showy sedge has no special federal status and is not a designated "Sensitive"

species in USFS Region 2 (USDA, 1994) or “Special Status” plant species by the BLM (USDI BLM, 1997).

### ***Conservation Status***

State	RANK	COMMENTS	SOURCE
South Dakota	S1	Critically imperiled due to extreme rarity.	NatureServe 2001.

### ***Conservation Status - Elsewhere***

State/Province	Rank	Comments	Source
Colorado	SR	Reported	NatureServe 2001.
Arizona	SR	Reported	NatureServe 2001.
Utah	SR	Reported	NatureServe 2001.
Nevada	SR	Reported	NatureServe 2001.
New Mexico	SR	Reported	NatureServe 2001.
Wyoming	NR	Not reported in the state	Fertig 2001; NatureServe 2001.
Mexico	NR	Not available	

NR – not ranked.

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## **Existing Management Plans, Assessments Or Conservation Strategies**

No other management documents were identified for southwestern showy sedge.

## **REVIEW OF TECHNICAL KNOWLEDGE**

### **Systematics**

Citation: L. H. Bailey, Bot. Gaz. 17:152. 1892.

There are approximately 2000 species of *Carex* worldwide (Walters and Keil, 1996), 533 North America (Cronquist *et al.*, 1994), and 80 in South Dakota (Biota of North America Project, 2001). Southwestern showy sedge, *Carex bella* Bailey, is classified as Division Magnoliophyta, Class Liliopsida, Subclass Commelinidae, Order Cyperales, Family Cyperaceae, Genus *Carex*, Section Atratae (Walters and Keil, 1996).

Alternative taxonomic treatments include:

*Carex atrata* var. *discolor* L. H. Bailey, J. Bot. 26:321. 1888.

*Carex uncomphgre* Kelso, Biol. Leafl. 38:1 – Colo.

### **Species Description**

#### ***Non-Technical***

Southwestern showy sedge, also commonly known as showy sedge or elegant sedge, is a rather robust, perennial, caespitose graminoid, 5 to 9 dm (1.5 to 3 feet) tall (Figures 3-4). Distinguishing characteristics include phyllopodic leaf sheaths with reddish-brown tinged margins or dots along margins, a long leaflike sheathing lowest bract, 4 gynaeandrous spikes with the terminal spike half staminate, and pistillate scales dark reddish brown and nearly as wide as, but generally shorter than the perigynia. Similar, yet sharply distinct from *Carex atrata*, southwestern showy sedge has a looser inflorescence, the spikes are more or less approximate, but not crowded, averaging longer (to 3 cm) and more slender than *C. atrata*, and at least the lower ones nodding on slender peduncles that often exceed the spike (Cronquist *et al.*, 1994).

### **Technical**

“Caespitose from short-creeping, fibrillose rootstocks; *culms* very slender, 5-9 dm. high, much exceeding the leaves, phyllopodic, cinnamon-brown and more or less strongly red-tinged at the base, the dried leaves of the previous year conspicuous; *leaves* usually 8-12 to a culm, scattered on the lower half, erect, flat, 3-6 mm. wide, long-attenuate, the sheaths ventrally dull-reddish-brown-tinged or dotted, the ligule as wide as long; *spikes* 3 or 4, the lower more or less drooping on slender, roughish peduncles 1.5-4 cm. long, the upper spikes erect, short-peduncled or subsessile, the uppermost contiguous, the others more or less strongly separate, gynaeandrous, the terminal spike half staminate, the lateral with only a few staminate flowers, linear to oblong-linear, 12-25 mm. long, 4-5.5 mm. wide, closely 15-30-flowered, the perigynia appressed, the terminal spike slightly wider; *lowest bract* short (2.5 mm. long), leaflike, sheathing, exceeding the head; *upper bracts* much reduced; *pistillate scales* ovate, obtuse to acute, dark-reddish-brown with lighter midrib usually conspicuous to the tip and shining white-hyaline margins, nearly as wide as, but shorter than, the mature perigynia; *perigynia* strongly flattened but swollen by the ripening achene, broadly oval to oblong-oval, 3-4 mm. long, 1.75-2 mm. wide, nerveless (except for the two marginal ribs) or lightly two- to three-nerved, whitish-green, little or not at all red-tinged, membranaceous, smooth, punctulate, rounded at the base, substipitate, rounded at the apex and abruptly beaked, the beak 0.3 mm. long, apiculate, shallowly bidentate; *achenes* obovoid or oblong-obovoid, 2-2.25 X 1.75 mm., trigonous, yellowish-brown, granular, substipitate, strongly apiculate.” (Hermann, 1970). Although Black Hills specimens have been readily defined as southwestern showy sedge, no comprehensive range-wide review of specimens has been undertaken for southwestern showy sedge, or the similar species, *Carex atrata*.

### **Species Significance**

Southwestern showy sedge is not reported to have any known special significance (e.g., public use, economic importance, medicinal use, ceremonial use, etc.). One report suggests it provides highly palatable forage for livestock, but it's limited range and scattered distribution renders it an insignificant resource for these purposes (Lewis, 1958). As a disjunct relict species, southwestern showy sedge may offer significance as a source of genetic diversity.

### **Distribution And Abundance**

Southwestern showy sedge occurs in the high mountains of Arizona and New Mexico, northern to central Utah, and northern Colorado and is reportedly disjunct in the Uinta Mountains of Utah, the Black Hills of South Dakota, and Nuevo Leon, Mexico (Cronquist *et al.*, 1994). Typical



habitat includes streambanks, meadows and moist woods or open slopes at high altitude in the mountains (e.g., 9000 to 10000 feet), often above timberline (Cronquist *et al.*, 1994).

In South Dakota, southwestern showy sedge is known only from the central core of the Black Hills within the Black Elk Wilderness and adjacent Custer State Park (Figures 5-6). The first observation of southwestern showy sedge in South Dakota was by McIntosh in 1924 from the Sunday Gulch area below Sylvan Lake in Custer State Park (Custer Co. SD: "Gorge below Sylvan Lake. Occasional in wet soil." Sept. 5, 1924, #9135 (SDU)) (McIntosh, 1931).

According to Ode (2001), southwestern showy sedge was collected again by Charles A Taylor and class on June 21, 1949 from "Rocky glade near outlet of Sylvan Lake" s.n. (SDC), by Robert F. Thorne on June 23, 1953 from "Vicinity of Sylvan Lake, Custer State Park." #12730 (SDU), and by Ted Van Bruggen on June 21, 1973 "Sunday Gulch, Sylvan Lake. Sect. 30, T2S R5E, North-facing rich loamy spruce woods." #6297 (SDU).

Ode collected southwestern showy sedge immediately below the outlet of Sylvan Lake along the steep hiking trail (center of Sect. 30) on July 22, 1987 from the base of a boulder in moist mineral soil, mostly shaded by cliffs, and, in that area, observed fewer than 5 plants (Ode, 2001). According to Ode (2001) no one has seen or collected southwestern showy sedge from that immediate vicinity since his 1987 collection, although Ode returned to the site on 2 June 1991 and did not observe any plants (but noted in his field notes that it was probably too early to recognize southwestern showy sedge). This sub-occurrence is believed to have been extirpated as a result of impacts from recreational use of an adjacent trail (Ode, 2001). In recent years, seven additional occurrences have been reported, four more in Custer State Park (although Ode considers two of these to be sub-occurrences of the overall Sunday Gulch population) and three in the Black Elk Wilderness on Black Hills National Forest (SDNHP, 2000, 2001). One of the Custer State Park occurrences is in a mossy gully between granite outcrops in the "Middle Earth" climbing area in the vicinity of Sunday Gulch (SDNHP, 2000). The three known occurrences of southwestern showy sedge on the Black Hills National Forest are at an elevation of approximately 6600 feet (SDNHP, 2000). Southwestern showy sedge tends to co-occur with Selkirk's violet (*Viola selkirkii*) in some areas of the Black Hills, although the flowering periods do not necessarily overlap, and is probably restricted to the same range, specifically the central granite core of the Black Hills at elevations above 5800 feet (Marriott, 2001a). Several of the recent Black Hills element occurrences of southwestern showy sedge were located during the course of general floristic or Selkirk's violet surveys (Marriott, 2001a). The recent discoveries of new stands coupled with the complex terrain of the granite outcrops suggest that additional occurrences and sub-occurrences of southwestern showy sedge are likely in the area. Additionally, southwestern showy sedge appears to be restricted to the Rock outcrop-Mocmont complex, 40 to 80 percent slope soil map unit (RkG), often slightly above the interface with the Buska-Mocmont-Rock outcrop complex, 10 to 40 percent slopes (BtE) soil map unit (USDA NRCS, 1990). Southwestern showy sedge tends to occupy gentle to moderate slopes among granite outcrops within areas of the RkG soil map unit.

### ***Distribution Recognized In Primary Literature***

See above, Distribution And Abundance. The Black Hills were not glaciated during the Pleistocene era and are known to have supported vegetation during that cooler and wetter period when coniferous forests may have linked the Hills with surrounding areas, including the Rocky Mountains to the west (Froiland, 1999). The preference of southwestern showy sedge toward

cool, moist habitat and its distribution across high mountains is consistent with a species that would have ranged farther and at lower elevation during the Pleistocene. As the climate became warmer and drier, such relict species are believed to have migrated upward in elevation in response to changing locations of favorable temperature and moisture conditions, ultimately occupying biological islands in the sky (Grayson, 1993). The geographic separation of the Black Hills from the Rocky Mountains has undoubtedly served as a major barrier to propagule and genetic material transfer between the Black Hills and other populations since the last ice age.

### ***Additional Information From Federal, State, And Other Records***

Potential risks and management needs for the Harney Peak site that includes southwestern showy sedge are discussed by Marriott (2001b). No additional information relevant to the Black Hills was available.

### ***Local Abundance***

There are eight Element Occurrence (EO) records for southwestern showy sedge in South Dakota, three in the vicinity of Sylvan Lake and two in the Little Devils Tower area in Custer State Park, and three in the adjacent Black Elk Wilderness on the Black Hills National Forest. These range from small, clustered stands, to scattered occurrences in drainages with suitable habitat, and reportedly range from fewer than 25 plants to over 200 flowering stems (SDNHP, 1973, 2000, 2001).

### **Element Occurrence Summary**

<b>EO Code#</b>	<b>EO Date, Location, Comments and Habitat</b>
field form 7/13/01; Marriott 12316 (RM)	7/13/2001, CSP ca. 0.3 miles WNW of Sylvan Lake, dam along small seasonal creek draining the "Middle Earth" climbing area, below the lowest of 3 small waterfalls. Small stand also found in gully between 2 granite outcrops just above and east of the lower falls. Site visited/photos (Glisson, 2001). Sub-occurrence in Sunday Gulch colony. At 6000-6200 feet, 50-75 flowering stems in 2 sites. In small wetland-under <i>Picea glauca</i> , <i>Betula papyrifera</i> . Between granite outcrops-on coarse granitic soil with mosses and <i>Viola selkirkii</i> . Variable aspect and slope, partial to well shaded, granite soil/substrate. Unsurveyed potential habitat remains outside of climbing area. In terms of overall health & vigor, Marriott (2001a) noted nothing obvious either positive or negative.
field form 7/11/01; Marriott 12315 (RM)	7/11/2001, CSP, "Picket Fence"-first ridge of rock outcrops N of Cathedral Spires. Most easily accessed from Trail #4, Cathedral Spires Trail, in shadier (deeper) gullies among rock outcrops. At 6750 feet, at least 200 flowering stems. Shady, moist areas in narrow gully bottoms between large granite outcrops with mosses, <i>Carex sprengellii</i> , <i>Viola selkirkii</i> , <i>Aconitum columbianum</i> , <i>Polygonum viviparum</i> , and occasional <i>Picea glauca</i> . Variable aspect and slope, partial to fully shaded, coarse, granitic soil. Hikers scramble up gullies close to trail, some rock climbing, but currently not a popular climbing area. This population appeared to be the most "vigorous" of those visited by Marriott (2001a) in that it was relatively large, occurred as multiple patches within a large area, and there were relatively many flowering stems.

EO Code#	EO Date, Location, Comments and Habitat
field form 7/18/01; Marriott 12326 (RM)	7/18/2001, Little Devils Tower in CSP, ca. 1.4 miles ENE of Sylvan Lake Dam, shortest access from Little Devils Tower parking area off Needles Highway (#87), in gully near head of large fins and pinnacles. At 6700 feet, ca. 50 flowering stems in microsite, but surely more elsewhere in large gully. Bottom of gully with high (up to 200') granite walls with <i>Elymus innovatus</i> , <i>Cystopteris fragilis</i> , and <i>Carex sprengellii</i> . Gully trends WSW, plants near base of N facing wall, coarse granitic soil, partially shaded. Very little land use. Overall health and vigor are basically unknown; there is a lot of unsurveyed potential habitat - a specimen was grabbed in passing (Marriott 2001a).
PMCYP031N O*005*SD	Harney Peak, located along base of steep rock face below summit on ne side. Access by traversing along base of ne face rather than climbing stairs to summit. Moss mat at base of steep nne-facing granite wall. Field form 8/3/2000; Marriott 12177 (RM), elevation 7100 feet. This colony is estimated to have consisted of less than 20 individuals, scattered along several hundred yards of cliff base (Marriott 2001a).
PMCYP031N O*001*SD	6/23/1973, CSP, 1st obs 1924 by McIntosh, Sunday Gulch below Sylvan Lake. Kolstad notes only 3 specimens from SD. Van Bruggen #6297 SD, 1973. Sub-occurrence in Sunday Gulch colony. Ode also collected a specimen from below the lake outlet in 1987, and noted a small colony consisting of fewer than 5 plants. This small colony has not been relocated and is believed to have been eliminated. At 6000 feet, colony size listed as occasional,. In wet soil of N-facing rich loamy spruce woods, also from rocky glade near outlet of Sylvan Lake. Marriott (2001a) had no comments regarding overall health and vigor.
PMCYP031N O*002*SD	6/21/2000, CSP, "Middle Earth" climbing area, ca. 0.5 miles WNW of Sylvan Lake dam. Marriott #11925 (RM). Sub-occurrence in Sunday Gulch colony. At 6000 feet, 25-30 above ground stems. Mossy gully between large granite outcrops. Marriott, H. 2001. Floristic Inventory of the Black Elk Wilderness, BHNF, SD. Unpublished report to GFP and BHNF. Regarding overall health and vigor, Marriott (2001a) commented "this particular spot has only a small population and there is some use by climbers (access)".
PMCYP031N O*003*SD	8/23/2000, Black Elk Wilderness, at head of Nelson Creek, ca. .4 miles SSW of Harney Peak lookout tower. Marriott #12302 (RM). At 6600 feet, 75-100 stems with mature fruit. Mossy, moist, narrow NNW-facing gully bottom shaded by overhanging granite wall. Marriott, H. 2001. Floristic Inventory of the Black Elk Wilderness, BHNF, SD. Unpublished report to GFP and BHNF. Regarding overall health and vigor, Marriott (2001a) commented "this population had no obvious problems but is small; but it is probably larger - plenty of potential habitat; area is remote and very little used".
PMCYP031N O*004*SD	8/10/2000, Black Elk Wilderness, N side of Lost Cabin Creek drainage in small side drainage almost due north of Little Devils Tower, ca. .6 miles SW of Harney Peak. Marriott #12225 (RM). Site visited/photos (Glisson, 2001). At 6600 feet, no size listed. At base of NW facing granite outcrop with <i>Fragaria virginiana</i> , <i>Picea glauca</i> , and <i>Elymus innovatus</i> . Marriott, H. 2001. Floristic Inventory of the Black Elk Wilderness, BHNF, SD. Unpublished report to GFP and BHNF. In terms of overall health & vigor, Marriott (2001a) noted nothing obvious either positive or negative.

Southwestern showy sedge occurrences in other portions of its range are generally described as occupying high mountain habitats (e.g., 9000 to 10000 feet) of the Rocky Mountains in Utah, Colorado, Arizona, New Mexico, and Mexico.

The relative scarcity of southwestern showy sedge in the Black Hills as opposed to Rocky Mountain occurrences may be due in part to the lower elevations of the Black Hills. Harney Peak, the highest point in the Black Hills has an elevation of 7242 feet and the highest known occurrence of southwestern showy sedge in the Black Hills is reportedly 6750 feet (SDNHP, 2000). This is over 2000 feet lower than elevations in the high mountain habitats where southwestern showy sedge reportedly occurs in the Rocky Mountains. However, the northernmost extension of the Rocky Mountain population in the Uinta Mountains of northeast Utah is approximately 200 miles south of the Black Hills which may account for some of the elevational variation. The narrow elevational range occupied by southwestern showy sedge in the Black Hills approaches the limits of suitable habitat the Black Hills has to offer.

### **Population Trend**

No specific population trend monitoring data is available, although one small sub-occurrence reported in the Black Hills from near the outlet of Sylvan Lake in Sunday Gulch in Custer State Park has not been observed since 1987 and is believed to have been extirpated, presumably due to recreational traffic (Ode, 2001). Population trend data for other Black Hills occurrences consists of health and vigor comments noted in the preceding section, Element Occurrence Summary, which were derived from cursory surveys (Marriott 2001a).

### **Broad Scale Movement Patterns**

The Black Hills populations of southwestern showy sedge are several hundred miles northeast of the nearest populations, which are in northeastern Utah and central Colorado, on the periphery of what appears to be the core population center in the southern Rocky Mountains. Southwestern showy sedge seeds are not likely to be effectively transported by wind for any great distance because of their relatively large size and lack of special adaptations that would favor wind transport as a dispersal mechanism (e.g., appendages). Water transport is conceivable on a localized basis, but not likely as a means of long range transport, especially in the absence of direct transfer routes. The most likely mode of transport under present climatic conditions is probably via migratory animals, primarily birds. Given the geographic isolation of the Black hills from the Rocky Mountain corridor, natural transfer of propagules (e.g., seeds or sprigs) under current climatic conditions is probably limited at best. While there is no data regarding seed transfer between existing populations, the relative continuity of the Rocky Mountains as a migratory corridor would be expected to provide a more favorable route for propagule transport compared to crossing the plains which separate the Black Hills. The disjunct Black Hills population of southwestern showy sedge may be an important source of genetic diversity, but natural transfer of seed material from other southwestern showy sedge populations or export to other suitable habitat is unlikely. If the Black Hills population were extirpated, it is unlikely that natural recolonization would occur.

### **Habitat Characteristics**

Little information is available regarding the absolute habitat requirements for southwestern

showy sedge in the Black Hills, and most of the existing information is observational or anecdotal, as opposed to experimental (see REVIEW OF TECHNICAL KNOWLEDGE, Distribution and Abundance, *Local Abundance - Element Occurrence Summary*). Observational evidence indicates that Black Hills occurrences of southwestern showy sedge are restricted to moist sites at high elevations (e.g., about 6000 feet or higher) in the central granitic core of the Black Hills, and are most commonly found in damp woods and along low order streams, often in partial to full shade. This is in contrast to a Region 4 Wetland Indicator status of FAC- (USDI FWS, 1988). In Utah, the elevational range extends from the aspen-fir upward to the lower alpine zone, between 9000 to 10000 feet (Welsh *et al.*, 1993). Across its range, southwestern showy sedge is reportedly adapted to medium to coarse soils, with high anaerobic tolerance and low calcium carbonate tolerance (USDA NRCS, 2001). This is consistent with Black Hills occurrences of southwestern showy sedge, where the species is known from coarse granitic soils, but does not occur in finer calcareous soils of the limestone plateau area of the Black Hills. Soil pH reportedly ranges from 6-7.5, and southwestern showy sedge is intolerant of saline soils (USDA NRCS, 2001).

Populations of southwestern showy sedge are quite restricted in range and habitat in the Black Hills. The species is found on the Black Elk Wilderness and adjacent Custer State Park along streams, adjacent to wetlands, in mossy fractures on granite outcrops, and along the base of northwesterly aspects of granite outcrops. Populations of southwestern showy sedge in Custer State Park range from 6000 to 6750 feet in elevation, whereas Black Hills National Forest occurrences range from 6600 to 7100 feet (SDNHP, 1973, 2000, 2001). These habitat areas would be expected to have relatively high humidity and soil moisture, and probably some of the more persistent snow packs in the Black Hills as a result of high elevation and shaded aspects. Subtle micro-topographic variability and varying soil moisture conditions may reflect habitat preferences in at least one of the Custer State Park occurrences where southwestern showy sedge occurs on the fringe of a small wetland area within a small seasonal drainage (Glisson, 2001).

Total annual precipitation at nearby Mount Rushmore National Monument, Black Hills, South Dakota averages 22.02 in (55.94 cm), with average temperatures ranging from 25.6 (-3.6 C) (January) to 69.6 F (20.9C) (July); precipitation is concentrated in the early summer months from May (4.11 in; 10.44 cm) through July (3.36 in; 8.53 cm); first frost is in mid-September to early October and last frost in mid-May to early June; average total annual snow fall is 57.9 in (147.1 cm); and extreme temperatures from 1962-2000 ranged from minus -38 to 100 F (-38.9 to 37.8C) (High Plains Regional Climate Center 2002). The Mount Rushmore National Monument reporting station is at an elevation of approximately 5000 feet, or 1000 to 1750 feet lower than occurrences of southwestern showy sedge, suggesting that colder, wetter conditions likely exist in occupied habitat.

A minimum frost free period of 120 days is reportedly required with tolerance of minimum temperature to -18<sup>o</sup> F (USDA NRCS, 2001) although actual frost free periods in the Black Elk Wilderness are likely shorter, and the documented low temperature in the vicinity of Black Hills southwestern showy sedge populations is -38<sup>o</sup> F. Southwestern showy sedge exhibits high moisture use and occurs in areas receiving from 10 to 40 inches of precipitation per year (USDA NRCS, 2001). The species reportedly has intermediate shade tolerance (USDA NRCS, 2001), although several of the Black Hills occurrences are located in full shade. At least one population in Custer State Park occurs in an area that may function as a cold air drainage, providing a pocket of more extreme (i.e., colder) microhabitat than surrounding areas (Glisson, 2001).

The limited information available from element occurrence records indicates that associated overstory species in the Black Hills include white spruce (*Picea glauca*) and paper birch (*Betula papyrifera*), but no canopy cover data were reported. Associated understory species may include moss, *Viola selkirkii*, *Aconitum columbianum*, *Circaea alpina*, *Polygonum viviparum*, *Carex sprengei*, *Cystopteris fragilis*, *Elymus innovatus*, and *Fragaria virginiana*. Recommendations for collection of additional baseline habitat and community ecology data are discussed under ADDITIONAL INFORMATION NEEDS.

## **Demography**

### ***Life History Characteristics***

Southwestern showy sedge is a relatively long-lived, slow-growing, erect, perennial bunch-grass, with the active growth period during spring and summer, and a slow after-harvest re-growth rate (USDA NRCS, 2001). The flowering period in Black Hills is July through August (Van Bruggen, 1976). Cold stratification is reportedly required for seed germination as is a minimum root depth requirement of 8 inches (USDA NRCS, 2001).

### ***Survival And Reproduction***

Members of the genus *Carex* are typically wind pollinated, but even the few insect pollinated species do not produce nectar (Walters and Keil, 1996). The flowering period for southwestern showy sedge in Black Hills is July through August (Van Bruggen, 1976). No specific information on pollination, mycorrhizal interactions, or hybridization is available for southwestern showy sedge.

Southwestern showy sedge may be propagated by seed germination or bare root and sprig transplants, but has low seed abundance, a low seed spread rate, and low seedling vigor (USDA NRCS, 2001). Seed dispersal may presumably be accomplished on a localized basis by wind, insects, animals, and water. Long range transport would most conceivably be accomplished via birds.

### ***Local Density Estimates***

Population densities for the three element occurrences on Black Hills National Forest are unreported, fewer than 20, and 75-100 flowering stems, respectively (SDNHP, 2000). The maximum reported population size for the five element occurrences in Custer State Park exceeds 200 flowering stems (SDNHP, 2001).

### ***Limiting Factors***

No specific information is available in the literature other than southwestern showy sedge is reportedly intolerant of drought, but may exhibit high fire tolerance (USDA NRCS, 2001). The availability of suitable habitat (e.g., cool, moist, shady sites at high elevations with coarse, granitic soils, low in calcium carbonates) is most likely the main limiting factor affecting the distribution and abundance of southwestern showy sedge in the Black Hills. The absence of the species from the limestone area of the Hills, which also have cool, moist shady microhabitats at higher elevations (6600-6700 ft) may be due to the presence of finer textured soils that are higher in calcium carbonates.

### ***Metapopulation Structure***

Based on a global heritage rank of G5, southwestern showy sedge is stable across its range, at least in the core area of the central Rocky Mountains. As regional disjuncts, the Black Hills populations may be inherently less secure due to the species' rarity, although they have likely persisted since the last glacial period, and the actual number of occurrences may be higher than presently known due to a lack of comprehensive surveys to date. If populations in the Black Hills area were extirpated, it is unlikely that natural recruitment from other extant stands would occur. The presence of element occurrences in the headwater portions of at least three separate drainages and generally broken topography of the area may provide some benefits to stability of the overall Black Hills population.

### ***Propagation Or Cultivation***

Southwestern showy sedge may be propagated by seed germination or bare root and sprig transplants, but has low seed abundance, a low seed spread rate, and low seedling vigor (USDA NRCS, 2001).

## **Community Ecology**

### ***Browsers Or Grazers***

Due to its widely scattered occurrences, southwestern showy sedge does not offer much value as a forage plant, although Lewis (1958) reported it is "highly palatable and would compare favorably with the better native bluegrasses". Mountain goats, although non-native to the area, are present in Black Elk Wilderness and Custer State Park and may use southwestern showy sedge habitat (Marriott, 2001c). In Colorado and Montana, graminoids (grasses, sedges, and rushes) comprised 96 and 56 percent, respectively of the summer diet of mountain goats (Chapman and Feldhamer, 1982, in USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, 2002). In South Dakota, species utilization by mountain goats is reportedly variable, with various lichens and branches of chokecherry (*Prunus virginiana*) being highly utilized during the summer. During the winter months, the diet consisted of about 60 percent mosses and lichens, 20 percent bearberry (*Arctostaphylos uva-ursii*), 10 percent needles and twigs (*Pinus ponderosa*), and 10 percent miscellaneous ferns, grasses, and woody species (Chapman and Feldhamer, 1982, in USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, 2002). Beyond selective pressures from grazing, trampling of soils might be expected to reduce soil moisture-holding capacity which might also adversely impact southwestern showy sedge due to its apparent ecological preference for moist sites.

### ***Competitors***

As a slow growing, slowly reproducing, cespitose species, southwestern showy sedge may not be a very competitive species, and would likely be adversely impacted by aggressive competitors, especially rhizomatous species such as Canada thistle (*Cirsium arvense*) and purple loosestrife (*Lythrum salicaria*) that also favor mesic to moist sites. The successional requirements of southwestern showy sedge are not well known, other than as noted previously, the fire tolerance and intermediate shade tolerance may suggest an early to mid-seral preference. Southwestern showy sedge is restricted to white spruce/paper birch dominated areas at high elevations in the Harney Peak area of the central Black Hills. These areas are presumed to be more heavily

forested than in prehistoric times as a result of fire suppression, thereby increasing light competition (USDA Black Hills National Forest, 1996). It has been suggested that historic fires in this area may have been less frequent, but hotter than lower, drier areas of the forest (USDA Black Hills National Forest, 1996).

#### ***Parasites, Disease, And Mutualistic Interactions***

No information is available.

#### ***Other Complex Interactions***

No information is available.

### **Risk Factors**

The three known occurrences on the Black Hills National Forest are in the Black Elk Wilderness. The Black Elk Wilderness is managed for wilderness values, and historic activities such as livestock grazing, timber harvesting, and mineral development are no longer permitted. Motorized vehicles are prohibited, but dispersed recreation such as rock climbing and hiking are permitted. As the Black Elk Wilderness is a headwater area managed for wilderness values, impacts to hydrology are not likely to pose a significant risk.

The Black Hills populations, as likely relicts of the last ice age, occupy habitat in sheltered (often with northwesterly aspects), cool, moist, high elevation areas. On a global scale, climate change may pose the greatest risk to southwestern showy sedge, especially since Black Hills populations are already concentrated in a fairly small area near the upper elevational range of the Forest. Prolonged regional warming and or drying trends may potentially threaten southwestern showy sedge populations if suitable microhabitat environmental conditions are eliminated.

Overall recreation use of Custer State Park and Black Elk Wilderness has been described as “intensive” (Marriott, 2001b), with the recreational load of Wilderness trails estimated at nearly 34,000 visitor days in 1995 (USDA Forest Service, 1997). Dispersed recreation activities such as hiking and rock climbing may pose risks to southwestern showy sedge due to trampling and physical removal. There was no evidence of any adverse effects at the population visited during background reconnaissance for this project (Glisson, 2001). Camping in Black Elk Wilderness is limited to dispersed, undeveloped sites and none of the popular climbing areas on the Forest are located near southwestern showy sedge occurrences (Burns, 2001). Occurrences of southwestern showy sedge in Custer State Park are in the vicinity of popular climbing areas, and while the species does not grow on climbing routes, it may be subject to trampling from climbing access traffic as well as hiking (Marriott, 2001c). The main risks to southwestern showy sedge in Custer State Park are trampling from climbing access traffic, hiking, and possibly mountain goats (Marriott 2001c).

The direct effect of fire suppression on forest succession as relates to southwestern showy sedge is not known, although the reported high fire tolerance and intermediate shade tolerance (USDA NRCS, 2001) may imply a preference for early to mid-seral conditions. To the extent that southwestern showy sedge is dependent upon moist sites, and increases in tree canopy cover have been linked to a loss of riparian resources in the Black Hills, localized adverse impacts may be anticipated to some degree as a result of soil moisture depletion and successional changes due



to past fire suppression (USDA USFS, 1996). It is also possible that continued fire suppression will allow further canopy closure of forested areas and may exceed the shade tolerance of southwestern showy sedge, although again, this is not known specifically. Personal observation of an element occurrence on Custer State Park suggests that southwestern showy sedge exhibits a fairly high degree of shade tolerance (Glisson, 2001). It is unclear if restoring the natural role of fire in the ecosystem, a desired management objective, will have any appreciable benefit or adverse impact on southwestern showy sedge (USDA Black Hills National Forest, 1996). Given an apparent preference for moist, sheltered sites in a landscape dissected by granite outcrops and canyons, the main natural disturbance regime may not have been fire, but more localized, smaller scale disturbance processes such as wind, snow-load induced tree-fall, and fluvial disturbance.

Livestock grazing is no longer permitted in Black Elk Wilderness and it's unlikely that livestock could wander into the area from adjacent active allotments in the Norbeck Wildlife Preserve (Luhrsen, 2001). No existing or future mineral leasing, exploration, development, or production is permitted in the Wilderness (Burns, 2001). Mountain goats, although non-native to the area, are present in Black Elk Wilderness and may use southwestern showy sedge habitat. In Custer State Park, mountain goats have formed trails and barren resting spots in rare plant habitat (Marriott, 2001c).

## **Response To Habitat Changes**

### ***Management Activities***

#### **Timber Harvest**

Not allowed in Black Elk Wilderness.

#### **Recreation**

Rock climbing and hiking are popular activities in many areas of the Black Elk Wilderness and Custer State Park (Marriott, 2001b). Neither Black Hills National Forest element occurrence is adjacent to existing trails, unlike the presumed extirpated small sub-occurrence in Sunday Gulch on Custer State Park. Southwestern showy sedge located at the base of potential climbing routes and in mossy gullies and fractures on granite outcrops may potentially be subjected to trampling or physical removal by climbers. Neither of the sites visited during preparation of this document (one in the Black Elk Wilderness and one in Custer State Park) showed evidence of adverse effects resulting from trampling or climbing (Glisson, 2001). As noted earlier, one small sub-occurrence reported in the Black Hills area from near the outlet of Sylvan Lake in Sunday Gulch in Custer State Park has not been observed since 1987 and presumably has been lost to hiking and climbing access traffic.

#### **Livestock Grazing**

Livestock grazing is no longer permitted in Black Elk Wilderness and it's unlikely that livestock could wander into the area from adjacent active allotments (Luhrsen, 2001).

#### **Mining**

No existing or future mineral leasing, exploration, development, or production is permitted in the

Wilderness (Burns, 2001).

### **Prescribed Fire**

The reported high fire tolerance and intermediate shade tolerance (USDA NRCS, 2001) may imply a preference for early to mid-seral conditions. Information relating to the fire ecology of southwestern showy sedge is limited, but prescribed fire is not expected to result in significant benefits or risks.

### **Fire Suppression**

Although southwestern showy sedge is reported to have a high fire tolerance, its successional status is not well understood. See discussion on possible responses in REVIEW OF TECHNICAL KNOWLEDGE, Risk Factors.

### **Non-Native Plant Establishment And Control**

There is no specific information available for southwestern showy sedge, although as a cespitose, slow growing species, it may not effectively compete with aggressive species capable of exploiting its habitat such as Canada thistle (*Cirsium arvense*) and purple loosestrife (*Lythrum salicaria*). Increased recreational traffic may result in increased transport of weed propagules into southwestern showy sedge habitat.

### **Fuelwood Harvest**

None allowed in Black Elk Wilderness.

### **Road Construction**

None allowed in Black Elk Wilderness.

### **Other**

Collection of plant specimens is not likely to pose a risk. Although the species may appeal to some amateur botanists, it is not likely to be sought after by the general public.

### ***Natural Disturbance***

#### **Insect Epidemics**

No information available.

#### **Wildfire**

Reportedly high tolerance to fire (USDA NRCS, 2001).

#### **Wind Events**

Wind events are another form of natural disturbance that tend to promote habitat heterogeneity and species and successional diversity. Wind induced tree-fall typically results in a new regeneration niche as increased light penetration tends to favor earlier successional forest species. Given an apparent preference for shaded sites in the Black Hills (SDNHP, 2000, 2001),

extensive tree-fall may adversely impact localized habitat areas. However, population locations in sheltered drainages and at the base of rock outcrops suggest that widespread damage across multiple Black Hills occurrences is unlikely. As a result, wind events are not expected to pose a significant risk to southwestern showy sedge. Tree-fall due to snow-loading would be expected to result in similar effects.

### **Flooding**

Southwestern showy sedge is apparently adapted to and possibly dependent on seasonal inundation and/or saturated soils. Adverse impacts due to destructive floods are unlikely due to the relatively high watershed position of occupied habitat. There is no information as to whether or not flooding is an important small scale disturbance factor in establishment of southwestern showy sedge.

### **Other Events**

Prolonged drought would be expected to adversely impact southwestern showy sedge, especially those occurrences in marginal microhabitats. Fires in southwestern showy sedge habitat would typically occur during droughts.

## **REVIEW OF CONSERVATION PRACTICES**

### **Management Practices**

No specific management practices have been applied in the Black Hills or are documented elsewhere for southwestern showy sedge. Many potentially beneficial management practices are already incorporated in the Land and Resources Management Plan for the Black Elk Wilderness, arising from a central theme to “protect and perpetuate natural processes” (USDA Black Hills National Forest, 1996). Wilderness management may include restoration of “fire to its natural role in the ecosystem”. Fire restoration may be beneficial by promoting habitat heterogeneity and potentially creating new recruitment sites although there is no documentation of fire having been used as a successful management tool for the species. Routing of trails away from known populations, and identification and control of invasive weedy species such as Canada thistle and purple loosestrife would likely benefit the species and has been recommended by Marriott (2001b). Management approaches that focus on “steering” recreational activities such as hiking, climbing, and camping away from known populations would likely benefit the species.

### **Models**

There are no currently known models for this species documented in the literature. As habitat components become better understood in the Black Hills, habitat level modeling with various GIS coverages could potentially be developed and used to assess potential habitat availability and quality and exclude low potential areas. This information could be used to prioritize future survey and management efforts. Any modeling effort would involve baseline and on-going collection of appropriate data. Microhabitat variables that may warrant tracking include elevation, aspect, soil map unit, precipitation, mean annual temperature, snowfall depth, frost-free days, annual maximum and minimum temperatures, geology, etc. This information may be

obtained from existing element occurrence data in South Dakota and surrounding states. Considering the limited available potential habitat due to elevation and soil constraints in the Black Hills, a simple review of shaded areas on northwesterly aspects supporting the RkG soil map unit may provide an efficient initial modeling approach.

### **Survey And Inventory Approaches**

There are no currently known survey or inventory approaches for this species documented in the literature. Comprehensive surveys for southwestern showy sedge could be completed in areas with suitable habitat at elevations above approximately 5800 feet in the central granite core of the Black Hills. Soil survey maps, in particular northwesterly/shaded aspects in the RkG soil map unit, may provide the best starting point for targeting additional surveys (USDA NRCS 1990).

Periodic follow-up surveys would verify continued presence of known populations and could identify new populations (e.g., resurvey potential habitat every 5 to 10 years) to ascertain if occupied range and populations are increasing, holding steady, or decreasing.

### **Monitoring Approaches**

There are no currently known monitoring approaches for this species documented in the literature. Documentation of existing occurrences of southwestern showy sedge utilizing a GPS system would be beneficial for monitoring the species. Periodic follow-up surveys could verify continued presence of known populations and could identify new populations (e.g., resurvey potential habitat every 5 to 10 years) to ascertain if occupied range and populations are increasing, holding steady, or decreasing.

Although not currently documented for southwestern showy sedge, collection of qualitative trend line data (e.g., estimation of population size by tallying the number of flower stems) may also be used to assess the stability of existing populations through time (Elzinga *et al.*, 1998). Although interpretation of such data may be problematic since no baseline data exists for this species in terms of year-to-year fluctuations, habitat specific variability, etc., this type of information is readily obtained and may provide very useful insights. If a substantial decrease is observed between visits (e.g., arbitrarily defined as 25 percent or greater), more sophisticated follow-up monitoring approaches could be devised and implemented as necessary to better assess microsite environmental requirements and populations trends. This may also serve as a trigger to review management practices.

## **ADDITIONAL INFORMATION NEEDS**

Comprehensive surveys of potential habitat in the Black Hills (e.g., northwesterly aspects and granite outcrops above 5800 feet) could reveal additional habitat information for this species. One of the priority areas for survey would be areas of rock climbing use within the granitic rock outcrops.

Utilizing a GPS data collection system to document known element occurrences could be beneficial (i.e., often improves location information).

Collection of additional baseline habitat and community ecology data for existing and future EO's could provide a better understanding of the absolute habitat requirements and improve the scientific basis for management of southwestern showy sedge in the Black Hills. Examples of useful information for each EO may include documentation of stream characteristics where appropriate, e.g., gradient, water table characteristics, flow variability (seasonal and episodic), etc. Additionally, documentation of snow pack characteristics, e.g., depth, persistence into spring/early growing season, etc., soil moisture potential throughout the growing season, and specific microclimate parameters, e.g., use of thermography to obtain site specific temperature and humidity data throughout the growing season could be useful. Collection of detailed eco-data, such as cover class estimates of all associated species, bare ground, soil texture classes, litter and duff, downed woody material, canopy cover, age class of woody species, etc., and detailed phenologic data for southwestern showy sedge in the Black Hills, e.g., time of leaf emergence, biomass, flowering period, seed set, ripening, and germination, seedling survival rates, longevity of individual plants, etc., could also provide information that may benefit management of this species in the Black Hills.

## LITERATURE CITED

- BONAP (Biota of North America Project). 2001. A synonymized checklist of the vascular flora of the United States, Puerto Rico, and the Virgin Islands. (July 1998-last update). Available: <http://www.csdl.tamu.edu/FLORA/b98/check98.htm>. Accessed October 12, 2001.
- Burns, L. 2001. Minerals Coordinator, Black Hills National Forest, Hell Canyon District. Conversation of October 23, 2001.
- Chapman, J. A., Feldhamer, G. A., eds. 1982. Wild mammals of North America. Baltimore, MD: The Johns Hopkins University Press. 1147 p.
- Cronquist, A., Holmgren, A., Holmgren, N. H., Reveal, J. L., and P. K. Holmgren. 1994. Intermountain Flora – Vascular Plants of the Intermountain West, U.S.A., Vol. 6 – The Monocotyledons. The New York Botanical Garden. 585 pp.
- Elzinga, C. L., Salzer, D. W., and J. W. Willoughby. 1998. Measuring and Monitoring Plant Populations. BLM Technical Reference 1730-1, Bureau of Land Management, National Business Center, Denver, CO.
- Fertig, W. F. 2001. Botanist, Wyoming Natural Diversity Database, University of Wyoming. Email correspondence of July 25, 2001, with Bruce Glisson.
- Froiland, S. G. 1999. Natural History of the Black Hills and Badlands. The Center for Western Studies, Augustana College. Sioux Falls, S.D. 225pp.
- Grayson, D. K. 1993. The Desert's Past – A Natural Prehistory of the Great Basin. Smithsonian Institution Press. Washington D.C. 356pp.
- Hermann, F. J. 1970. Manual of the Carices of the Rocky Mountains and Colorado Basin. Agricultural Handbook No. 374. USDA Forest Service. 397 pp.
- Hurd, E. G., Shaw, N. L., Mastroguiseppe, J., Smithman, L. C., and S. Goodrich. 1998. Field Guide to Intermountain Sedges. USDA USFS Rocky Mountain Research Station. RMRS-GTR-10. June 1998. 282 pp.
- ITIS. 2001. Retrieved [Bruce Glisson, July 18, 2001], from the Integrated Taxonomic Information System on-line database, <http://www.itis.usda.gov>.
- Lewis, M. E. 1958. Carex - Its distribution and importance in Utah. Brigham Young University Science Bulletin. Biological Series – I:II. January 1, 1958.
- Luhrsen, D. 2001. Rangeland Management Specialist. Black Hills National Forest, Mystic Ranger District. Conversation of October 23, 2001.
- Marriott, H. 2001a. Botanist. Conversation of October 25, 2001.
- Marriott, H. 2001b. Floristic inventory of the Black Elk Wilderness, Black Hills National Forest, South Dakota. Prepared for the SD Dept. of Game, Fish & Parks, Wildlife Division, and Black Hills National Forest, Hell Canyon Ranger District.
- Marriott, H. 2001c. Identification and mitigation of climber impact on rare plants, Custer State Park, South Dakota (Black Hills Needles Climbing Area). Unpublished report to The Access Fund, Boulder CO; and the South Dakota Department of Game, Fish and Parks, Pierre, SD.

- McIntosh, A. C. 1931. A botanical survey of the Black Hills of South Dakota. *The Black Hills Engineer* 19(3): 157- 277.
- NatureServe: An online encyclopedia of life [web application]. 2001. Version 1.4 . Arlington, Virginia, USA: Association for Biodiversity Information. Available: <http://www.natureserve.org/>. (Accessed by Bruce Glisson: August 17, 2001 ).
- Ode, D. 2001. Botanist/Ecologist, South Dakota Game, Fish and Parks. Conversation of October 22, 2001.
- SDNHP (South Dakota Natural Heritage Program). 1973, 2000. Element Occurrence records for *Carex bella*.
- SDNHP (South Dakota Natural Heritage Program). 2001. Element Occurrence field form for *Carex bella*, draft records for three new Element occurrences located during July, 2001, received from Hollis Marriott.
- U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2001, May). Fire Effects Information System, [Online]. Available: <http://www.fs.fed.us/database/feis/> [Bruce Glisson, July 18, 2001].
- USDA Black Hills National Forest. 1996. Land and Resource Management Plan for the Black Hills National Forest. Custer, South Dakota.
- USDA Forest Service. 1994. Region 2 Forest Service Manual. Supplement No. 2600-94-2.
- USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, January). Fire Effects Information System, [Online]. Available: <http://www.fs.fed.us/database/feis/> [accessed by Bruce Glisson, January 28, 2002].
- USDA NRCS. 1990. Soil Survey of Custer and Pennington Counties, Black Hills Parts, South Dakota. Sheets 20 and 13. 295pp.
- USDA NRCS. 2001. The PLANTS Database, Version 3.1 (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA [Bruce Glisson, July 18, 2001].
- USDA USFS. 1996. A Century of Change in Black Hills Forest and Riparian Ecosystems. Publication B 722. 20 pp.
- USDA Forest Service. 1997. 1997 Revision: Land and Resource Management Plan for the Black Hills National Forest. Custer, South Dakota.
- USDI BLM. 1997. Montana/Dakotas State Director's Special Status Plant Species List. May, 1997. Telephone discussion of October 22, 2001 with Ms. Roxanne Falise.
- USDI FWS (Fish and Wildlife Service). 1988. National List of Plant Species that Occur in Wetlands: Intermountain (Region 4). PB89-128730. National Technical Information Service. Springfield, Va. 77pp.
- Van Bruggen, T. 1976. The Vascular plants of South Dakota. Iowa State University Press. Ames, Iowa.
- Walters, D.R. and D. J. Keil. 1996. Vascular Plant Taxonomy, 4<sup>th</sup> ed. Kendall/Hunt Publishing Co. Dubuque, Iowa. 608 pp.
- Welsh, S. L., Atwood, N. D., Goodrich, S., and L. C. Higgins. 1993. A Utah Flora. 2<sup>nd</sup> Ed.

## DEFINITIONS

### THE NATURE CONSERVANCY NATURAL HERITAGE RANKS

GLOBAL RANK (G): based on range-wide status of a species

- G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction. (Critically endangered throughout its range).
- G2 Imperiled globally because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range. (Endangered throughout its range).
- G3 Vulnerable throughout its range or found locally in a restricted range (21 to 100 occurrences). (Threatened throughout its range).
- G4 Apparently secure globally, though it might be quite rare in parts of its range, especially at the periphery.
- G5 Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- GX Presumed extinct
- GQ Indicates uncertainty about taxonomic status.
- GU Unable to assign rank due to lack of available information.
- G? Indicates uncertainty about an assigned global rank.

TRINOMIAL RANK (T): used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.

STATE RANK (S): based on the status of a species in an individual state. S ranks may differ between states based on the relative abundance of a species in each state.

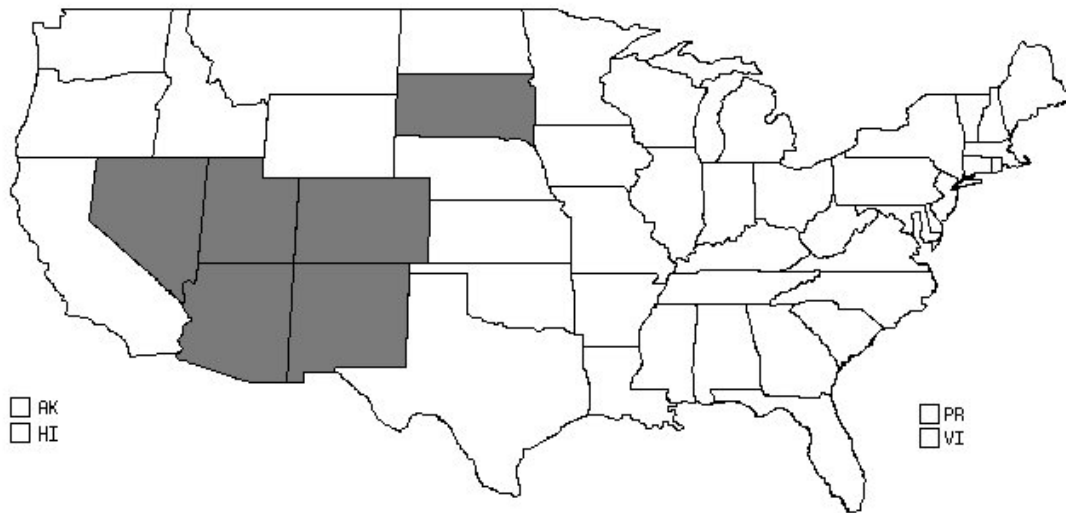
- S1 Critically imperiled in state because of extreme rarity (5 or fewer occurrences, or very few remaining individuals, or because of some factor of its biology making it especially vulnerable to extirpation from the state. (Critically endangered in state).
- S2 Imperiled in state because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extirpation from the state. (Endangered or threatened in state).
- S3 Vulnerable in state (21 to 100 occurrences).
- S? Indicates uncertainty about an assigned state rank.
- SR Reported



## FIGURES

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**Figure 1.** US Distribution for southwestern showy sedge (BONAP, 2001). Grey areas indicate confirmed presence.



**Figure 2.** South Dakota Distribution for southwestern showy sedge (USDA NRCS, 2001).



**Figure 3.** Line drawing for southwestern showy sedge from Hermann (1970).



**Plate 133. CAREX BELLA**

**Figure 4.** Photographs and line drawings of southwestern showy sedge (Hurd et al.,1998).



*Carex bella*. (A) Inflorescences, (B) pistillate scales, (C) perigynia, (D) achenes. B through D: Left—dorsal view; right—ventral view.



**Figure 5.** Photograph of southwestern showy sedge habitat, north side of Lost Cabin Creek drainage, Black Elk Wilderness Area, Black Hills National Forest (Glisson, 2001).



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**Figure 6.** Photograph of southwestern showy sedge habitat, small wetland below “Middle Earth” climbing area, Custer State Park, (Glisson, 2001).

